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AUTOMATIC X-RAY NEGATIVE ANALYSIS PROGRAM (AXNAP)

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JUNE 1976

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PICATINNY ARSENAL
DOVER, NEW JERSEY

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Automatic X-Ray Negative Analysis Program (AXNAP) is a computer software program developed for use on Control Data Corporation's Computer No. 6600 interfaced with Tektronix Terminal No. 4014/15 enhanced graphics module. Accompanying this hardware is Tektronix Tablet No. 4954 which has the capability of translating tablet coordinate data into digital positions on the terminal screen with an accompanying transfer to a CDC 6600 buffer. A hard-copy unit is also part of the hardware.

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20. ABSTRACT (Continued)

AXNAP is an improved concept of x-ray data analysis which provides accurate data more quickly than other methods and does not require specially trained technicians.

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INTRODUCTION

In the present method of x-ray data analysis, the data is read by an x-ray technician trained in using a line grid. The area of the defect is determined by counting grid squares; the width, by counting the number of grid spaces between two end points; and the height, by counting the grid spaces from the base of the shell. Once this information is obtained, it is recorded and punched on cards. In addition to requiring specially trained personnel, the procedure is tedious, time consuming, and subject to inaccuracies.

The Automatic X-Ray Negative Analysis Program (AXNAP) is an improved concept of x-ray data analysis. It provides the same information as the method described above, but does so more quickly and accurately, and does not require a specially trained technician. The operator need only follow a menu using a digitized pen for entering shell data. All information is compiled in report form automatically, eliminating the necessity of recording data and punching cards. As a result, the area calculations, end points, etc., are more accurate than those determined by the grid method.

DEVELOPMENT

A menu was developed which allows the operator to process x-rays without any knowledge of the computer hardware involved. This menu (Fig 1) enables the technician to input shell data without using the Tektronix keyboard.

The menu is placed on the tablet in any position and is oriented by the operator's entering points one and two, as shown in Figure 1. The x-ray may also be placed in any position on the tablet. The shell shown on the x-ray is oriented with respect to the menu by the operator's entering one point on the annular ring and a second point on the distal end of the shell (see Fig 2). The final results of the defect data analysis are referenced to the base of the shell. For area calculations of a particular defect, the operator enters as many points as desired in a single-point mode. Continuous mode operation for tracing areas will be incorporated into AXNAP when a buffer is added to the CDC hardware.

AXNAP provides many checks and rechecks for detecting operating errors. Operators are allowed to re-enter input data at various points in the program (see Operating Procedure, below). As the shell defect data is processed, the results are displayed on the Tektronix terminal screen, which will accommodate a maximum of 32 lines of data. The operator also has the option of using less than 32 lines and starting a new page if desired. In each case, a hard copy of the page is generated as it is completed. In addition, a line print of the total output can be retrieved after the last shell is analyzed.

The components of the system are shown in Figures 3 and 4.

OPERATING PROCEDURE

Preliminary Instructions

1. Gain access to the CDC 6600 central processor by using the Tektronix terminal interface.

2. Attach the file on which AXNAP is located.

3. Orient the menu by following the instructions displayed on the Tektronix screen.

Shell Processing (Refer to menu, Figure 1)

1. Enter one point in Blocks I, II, and III, then strike "Continue."

2. Omit Block IV (to speed up operation).

3. Enter shell, group, and lot numbers as the first three entries in Block V, using a maximum of 11 points each. Check the Tektronix display screen to verify accuracy of the input data. If data is correct, strike "Continue;" if not, correct error by striking "Error Re-enter" and entering correct data in appropriate

sub-block before striking "Continue."[1] ("Continue" must be struck before shell is oriented.)

4. Orient the shell (as shown on the x-ray) by placing the pen on the point 1 (the annular ring) and striking "Continue," then on point 2 (the distal end) and striking "Continue." This orients the shell with respect to the menu; however, the shell can be positioned either vertically or horizontally, as the operator chooses.

5. Select the defects to be analyzed and enter points in Block VI as follows:

a. For the first three defects in Block VI (cavity, piping cavity, and porous area), enter two end points, then strike "Continue." Trace the area over each of the three defects to permit the low point to be calculated by AXNAP.

b. For the next three defects (annular ring, base separation, and crack), enter the low points and strike "Continue." Use Block VII to approximate the width of the defect.

c. For the remaining six defects, simply enter the lowest point on the defect and strike "Continue."

d. Use "New Page" to generate a hard copy of the existing page and begin a new one, as desired.

6. After the defects for one shell have been analyzed, move on to the next. If it is a new type of shell, enter all of the required information, starting with Block I. If it is the same type as the previous shell, start with Block V. Use the "Same" block to indicate that the preceding shell number, group number, or lot number is being re-entered. Use the "Next" block to increment the shell number by adding "1." (This saves the time required to enter a new shell number.)

7. Orient the shell as indicated in Step 4, above, before entering points in Block VI.

---

[1]At any point that the operator is aware of entering the wrong block, he can correct the error by striking "Error Re-enter" and entering the correct block. If he hits the correct block but the transmission is incomplete because of heavy usage of the system, a bell will ring. In this case, it is not necessary to strike "Error Re-enter" before re-entering the correct block.

8. In Block VI, enter "New Shell Type" or "Small Shell Type," as appropriate, and continue entries, as described in Step 5, above.

Sample Output

Table 1, which shows the defect analysis of a 105 mm shell, is typical of AXNAP's output.

Note that the "Total Def" column is cumulative for each defect analyzed. The low point and end points 1 and 2 for each defect are given in coordinates referenced to the base of the shell.

Table 1

Sample output

PROJECTILE-105MM M1 AMATEX X-RAY FILM READING(DEC,1975) PAGE- 1
SHELL NO. 012346789 GROUP NO. AB

TOTAL DEF -.5856	DEF TYPE	LOW POINT		END POINT 1			END POINT 2		LOT NO. WIDTH	KL-N/T AREA
1.	01 CAVITY	-.550	5.780	-1	.556	5.824	-.598	5.834	.9582	1.0093
1.	02 PIP CAV	-.550	14.966		.820	4.999	3.271	7.373	3.4117	3.1175
3 1.	03POROSITY	-.550	6.826	-1	.172	6.798	-.556	6.826	.6169	.1394
1.	04 ANNRING	-1.15	5.84						1/8 LT 1/4	
2.	04 ANNRING	1.97	3.62						GT 3/8	
3.	04 ANNRING	2.24	7.42						1/4 LT 3/8	
1.	05 BASESEP	1.91	5.64						LT1/64	
2.	05 BASESEP	2.11	9.12						1/64LT1/32	
3.	05 BASESEP	.23	7.23						1/32LT1/16	
4.	05 BASESEP	-2.03	10.49						GT 1/16	
1.	06CRACK	.89	8.63						GT1/8	
2.	06CRACK	.47	5.85						LT 1/32	
1.	20 FOR MAT	.86	3.16							

NOTE: The spacing in the fourth column (END POINT 1) is wrong due to computer error. The first and third entries should read "-1.556" and "-1.172."

Table 1 (Continued)

PROJECTILE-105MM M1 AMATEX X-RAY FILM READING(DEC,1975) PAGE- 2
SHELL NO. 01 2346789 GROUP NO. AB

TOTAL	DEF	DEF TYPE	LOW POINT		END POINT 1			END POINT 2		LOT NO. WIDTH	KL-M/T AREA
1.		31 METIREG	.73	5.11							
1.		MET DEF	-.89	5.58							
1.		41 PEL CRK	-.89	6.23							
1.		42 PEL MIS	-2.16	7.48							
2.		31 METIREG	-.97	5.73							
2.		20 FOR MAT	1.94	4.30							
1.		43 PEL BRK	2.00	2.82							
4.		04 ANNRING	1.21	4.40						LT 1/8	
2.		02 PIP CAV	-1.552	5.813	-1	.561	5.870	-.586	5.854	.9752	.0014
3.		06CRACK	.22	5.03						GT1/8	
2.		03POROSITY	-1.552	5.828	-1	.516	4.764	-.585	4.816	.9316	.3677
3.		31 METIREG	.55	3.89							
2.		41 PEL CRK	.60	5.95							

NOTE: Entries in the fourth column (END POINT 1) should read "-1.561" and "-1.516."

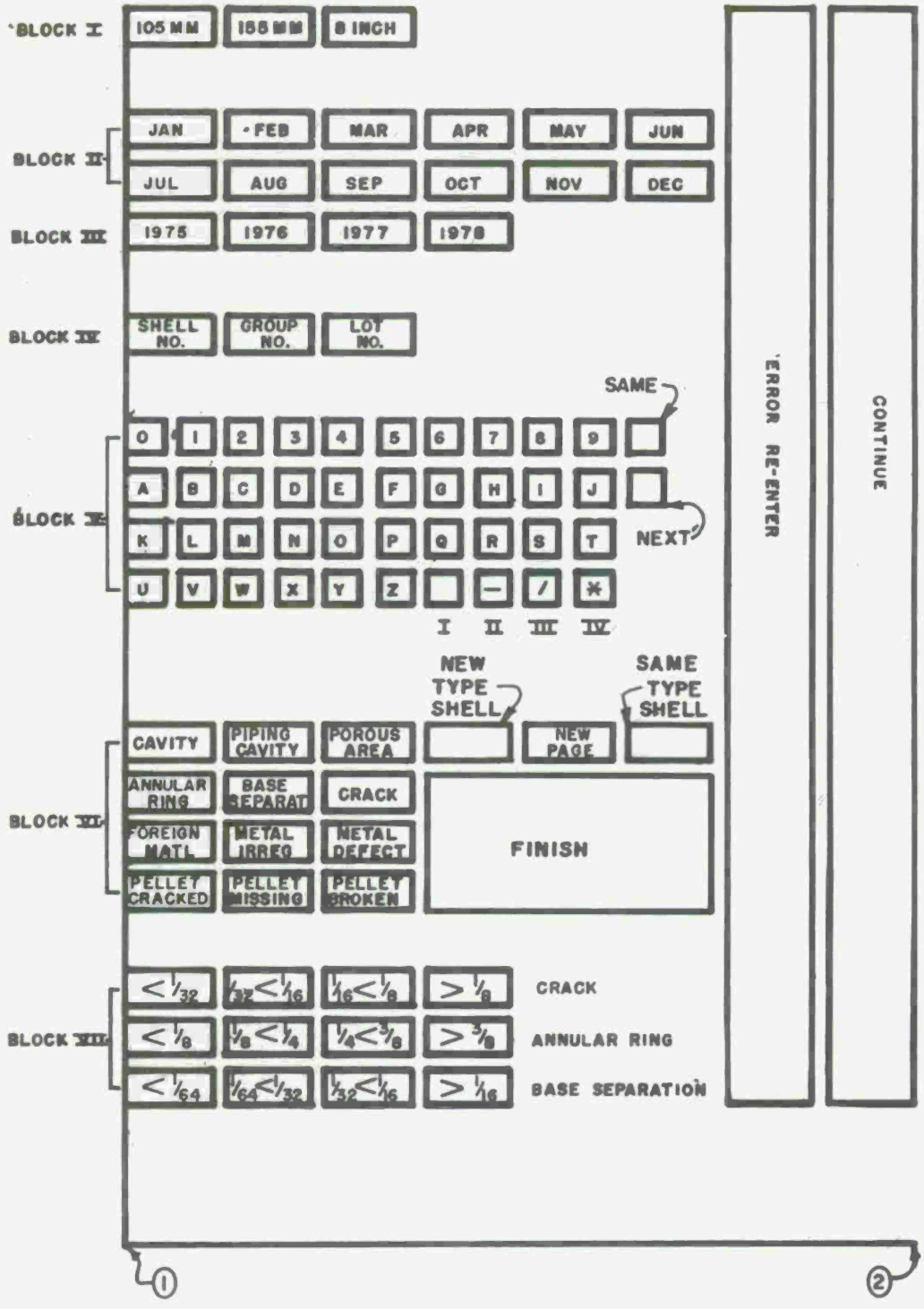

Fig 1 AXNAP menu

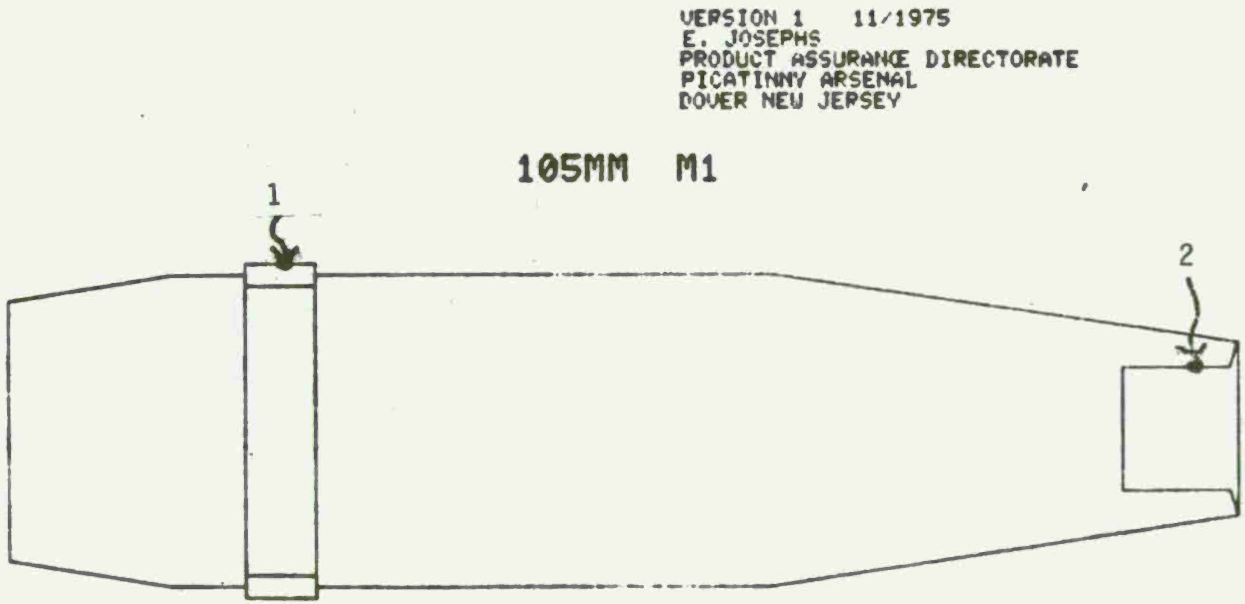

Fig 2 Vertical orientation of 105 mm shell

Fig 3 AXNAP components

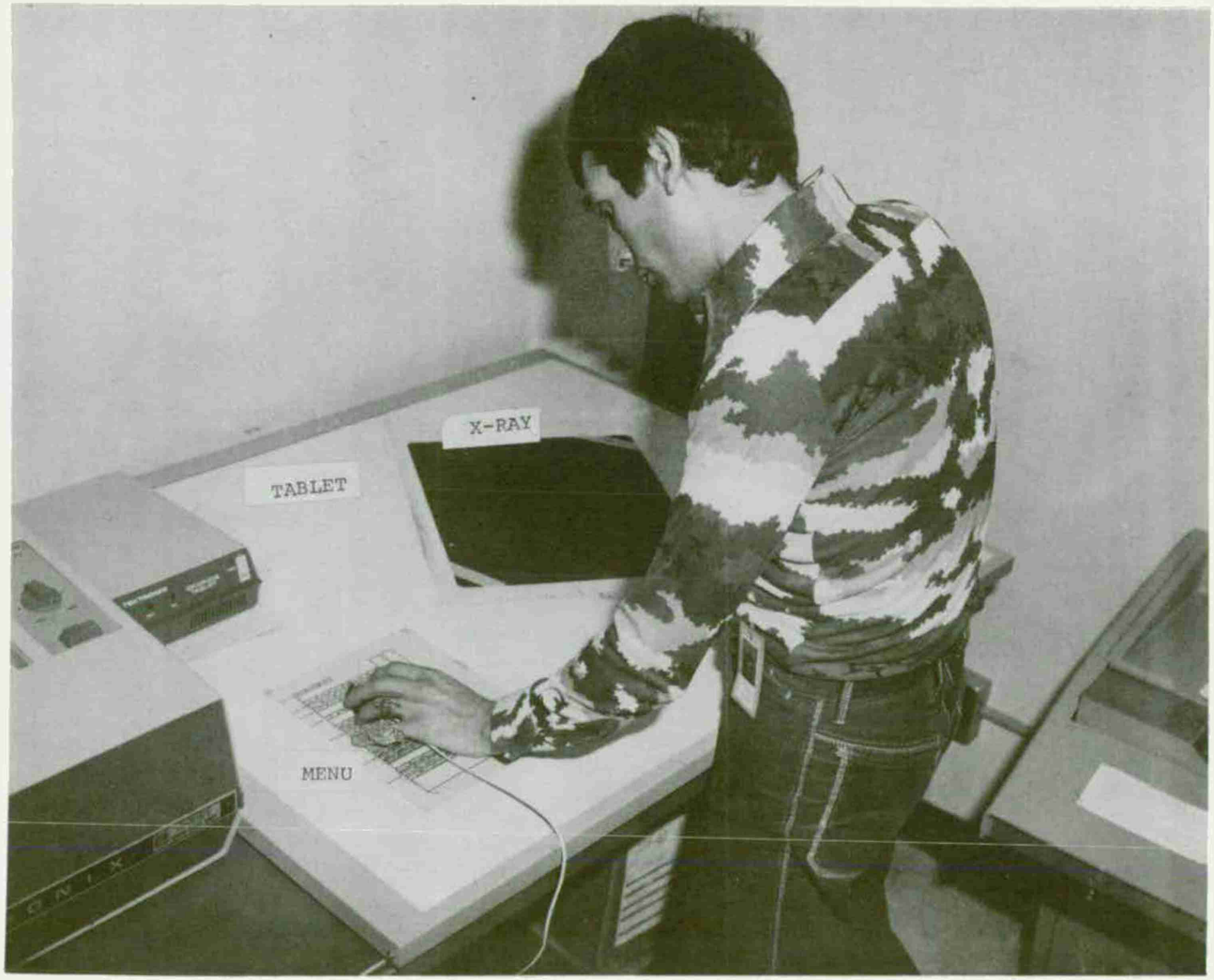

Fig 4 AXNAP components in use

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